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April 11, 2002

RAUL R. RODRIGUEZ
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Mr. William F. Caton
Acting Secretary
Federal Communications Commission
445 12th Street, S.W.
Washington, D.C. 20554

Re: Ex Parte Presentation in IB Docket No. 01-96

Dear Mr. Caton:

Pursuant to Section 1.1206 of the Commission's Rules, 47 C.F.R. § 1.1206, this letter provides notice that on April 10, 2002, Gerald Helman of Virtual Geosatellite, LLC ("Virtual Geosatellite") and undersigned counsel met with Mr. Sam Feder, Senior Legal Advisor to Commissioner Martin.

Virtual Geosatellite's representatives presented the enclosed briefing regarding issues under consideration in the ongoing referenced proceeding.

Virtual Geosatellite's representatives also made available recent articles that have appeared in the *New York Times* and *Wall Street Journal* (copies attached) regarding the shortage of spectrum and satellites required for new and essential military systems. These systems include unmanned aeronautical vehicles such as the Predator and Global Hawk and an unmanned fighter aircraft being developed by Boeing. Virtual Geosatellite's technologies can make available the satellite slots and broadband spectrum for future defense systems and commercial applications for years to come.

The original and one copy of this letter are submitted for inclusion in the record of the referenced proceeding.

Sincerely,

Raul R. Rodriguez
Counsel to Virtual Geosatellite, LLC

RRR:rjc
Enclosures

cc (w/ encl. by e-mail): Mr. Sam Feder

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Virtual Geostationary Orbit:

Maximizing Opportunities for the Use of the Ku-Band for Present and Future NGSO FSS Systems

virtual geo

Virtual Geo Initial Position:

- Option 4, Homogeneous Constellations, provides the best opportunity for:
  - Multiple entry of NGSO systems into Ku-band;
  - Ensuring full protection of GSO FSS and BSS networks; and
  - Maximizing the use and utility of the NGSO FSS spectrum at Ku-band.
- Option 3, Avoidance of In-Line Interference Events, is:
  - Unduly complex (requiring continuous and unprecedented levels of operator-to-operator interaction);
  - Punitive to systems (e.g., HEO NGSO systems) that do not employ the mitigation technique of satellite diversity to protect the GSO; and
  - An inefficient user of the orbital/spectrum resource in that each heterogeneous system ties up roughly one-third of the available Ku-band spectrum worldwide.

SkyBridge Initial Position:

- Allow SkyBridge unfettered access to 1000 MHz of spectrum in each direction, exactly as it proposes, with no obligation on SkyBridge to adjust its parameters to facilitate intersystem sharing.

Virtual Geo Initial Proposal in IB Docket No. 01-96:

- Split all available bands roughly evenly between Virtual Geostationary Satellite Orbit (VGSO) systems on the one hand and SkyBridge and other in-line avoidance proponents on the other. All NGSOs can use VGSO spectrum, subject to the obligation to protect VGSO satellite arcs. Virtual Geo provided full details and proposed rules showing how the FCC would define and license VGSO systems.

SkyBridge Position in IB Docket No. 01-96 (February 2002):

- Adopt Option 3.
- Regardless of what Virtual Geo says, it can do satellite diversity.
- SkyBridge cannot survive with anything less than 1000 MHz of spectrum in each direction.

Virtual Geo Concerns with Skybridge's Unchanged Position:

- The mitigation technique of satellite diversity is not available to Virtual Geo or most other HEO systems.
- HEO-type NGSO systems are able to operate with a small fraction of the number of satellites that low Earth orbit NGSO systems use because HEOs do not need to use satellite diversity to share with GSO systems.
- If satellite diversity were to be required for Virtual Geo or other HEOs, the extra satellites, extra orbits, and infinitely more complicated ground segment that would be the inevitable consequences of such a requirement would defeat entirely the design and cost advantages associated with the innovative VGSO architecture.
- As for the amount of spectrum, SkyBridge has never provided any technical or economic justification whatsoever for its oft-stated requirement for access to 1000 MHz of Ku-band spectrum in each direction.

Virtual Geo Compromise Proposal for IB Docket No. 01-96 (February 2002):

- Adopt Option 3 with a tweak. Rather than leave NGSO systems to coordinate with each other on an ad hoc basis to resolve in-line interference situations, the Virtual Geo approach would, in effect, pre-coordinate VGSO systems by rule, as follows:
  - When there is an in-line event between a VGSO satellite and a non-VGSO satellite, the VGSO system defaults automatically to a fixed portion of the available spectrum and the non-VGSO system defaults to another portion of the band.

Virtual Geo Compromise Proposal for IB Docket No. 01-96 (February 2002):

(continued)

  - This approach would apply whether there is one VGSO system (defined as per Virtual Geo's initial comments in IB Docket No. 01-96) or ten. As all VGSO satellites follow the same ground tracks, the avoidance obligation on any non-VGSO system would be the same in either case.
  - All systems would be licensed to operate across all spectrum available for NGSO FSS use at Ku-band, subject to the limited avoidance obligation above.

- Option 3, as SkyBridge envisions it, would apply as between non-VGSO NGSO FSS systems whenever in-line events occur between them; in-line events would never occur as between VGSO systems due to the design of the constellations.

Advantages of Virtual Geo Compromise Proposal:

- Preserves nearly all of what SkyBridge says it wants under Option 3.
- Creates the opportunities for optimization of the spectrum promised by the VGSO design.
- Provides opportunity for equitable access to Ku-band NGSO FSS spectrum by developing countries.
- Allows the marketplace, and not the regulators, prove the validity of Virtual Geo's claims of superiority of design, and does so in a way that allows SkyBridge and others to make their best cases as well.
- Radically improves the likelihood of global adoption of a spectrum assignment approach for Ku-band NGSO FSS systems.
- May provide a model for NGSO licensing in other bands.

Disadvantages of Virtual Geo Compromise Proposal:

- NONE

www.nytimes.com
The New York Times ON THE WEB

March 31, 2002

The Pilot, Gone. The Market, Huge.

By RUSS MITCHELL

Last fall, when Boeing (news/quote)'s bid to build the F-35 Joint Strike Fighter flamed out and the $200 billion winner-take-all contract to supply up to 3,000 planes went to its rival, Lockheed Martin, a good part of Boeing's plans went up in smoke. Designed for the Air Force, the Navy and the Marines, the F-35 will be the last new manned American fighter for decades to come.

But, as things turned out, Boeing's warplane operations were set back only momentarily. The company is moving on to the next generation of combat planes: robotic, pilotless aircraft.

Early this summer, the first test flight of Boeing's X-45 strike aircraft, with no pilot aboard, will take to the skies over Southern California. Far more sophisticated than the Predator surveillance planes flying over Afghanistan, the X-45 is being designed as a full-fledged attack plane. When called to duty, swarms of them would strike deep into enemy territory to knock out antiaircraft sensors and missile batteries. The highly risky mission would clear a path for aircraft with pilots, saving them from danger.

If the X-45 works — and it will take six years to find out — there is no reason that it could not do the work of other manned-fighter missions, taking some of those 3,000 orders away from Lockheed Martin. The X-45 is a lot cheaper: Boeing is aiming to build and operate the robot fighter at one-third the cost of the F-35.

While pilotless aircraft are not new, the idea that a robot plane could replace an Air Force fighter pilot was, until recently, the stuff of futurist science magazines.

"Five years ago, people said it was ridiculous," recalled Michael Heinz, who heads Boeing's Unmanned Systems unit, created last November. But rapid advances in computer and communications technology, combined with the success of the Predator surveillance aircraft in Afghanistan, have turned battlefield commanders into true believers. In the process, a significant new market is being created within the military industry.

Frost & Sullivan, a research group in San Antonio, forecasts that the market for U.A.V.'s, or unmanned aerial vehicles, will be worth nearly $5 billion by 2005. Mr. Heinz and other executives at military contractors see an annual market of at least $10 billion by decade's end, with growth continuing at double-digit rates for a decade or more.

No one expects robotic aircraft to make up for Boeing's woes in the commercial aircraft business or for immediate cutbacks threatened for the F/A-18 Hornet for the Navy. Still, Mr. Heinz sees the U.A.V. program as potentially huge: "What defines a huge business for Boeing? We're a $58 billion business. A billion in revenue qualifies."

But Mr. Heinz wants a lot more than that. A Pentagon planning document called Joint Vision 2020 forecasts that one-third of the military's combat planes by that year will be robotic.

Military contractors also have their eyes on civil and commercial markets. If the Federal Aviation Administration certifies the plane — a lengthy process, with no sure results — contractors envision U.A.V.'s monitoring the skies of America in the name of domestic security.

Aviation consultants say they cannot imagine the government or the public accepting pilotless commercial airline travel — even though computers have taken over large pieces of commercial pilots' tasks. But robotic planes are becoming progressively better at takeoff and landing, and the idea of pilotless FedEx (news/quote) and U.P.S. transoceanic flights is technically plausible by the end of the decade.

Robot cargo planes could eventually bolster Boeing's commercial aircraft line, which is suffering from cutbacks in orders since Sept. 11. "We want to lead the transformation across the entire U.A.V. spectrum: solutions for military, civil, commercial," Mr. Heinz said.

That is an ambitious goal for a company that is effectively a start-up in a field that has plenty of competition.

Already in the business are giants like Northrop Grumman — which has a long history in U.A.V. development through its purchase of Ryan Aeronautical — as well as many smaller companies. Dozens of U.A.V.'s, in a variety of sizes and shapes, are in development. They include fantastical palm-size, insectlike fliers bearing tiny spy cameras; small helicopters that could airlift a wounded soldier; and full-size armed warplanes like the X-45.

Some are in use and have proved themselves in battle. The Cessna-size Predator, built by General Atomics Aeronautical Systems, is fitted with radar, infrared and video sensors and armed with Hellfire missiles. The Global Hawk, a 26,000-pound surveillance plane, can cross oceans without refueling or loiter for 36 hours at 65,000 feet above a battlefield — well out of the range of most antiaircraft missiles. The Global Hawk, also deployed in Afghanistan, is built by Northrop Grumman as a replacement for the U-2 spy plane.

Success over Afghanistan has spread enthusiasm in the military for robotic aircraft. Gen. Tommy R. Franks, commander of the military operation in Afghanistan, has called the Predator "my No. 1 sensor for tracking down Al Qaeda," according to Lt. Col. Douglas Boone, the Air Force officer in charge of acquiring spy planes. President Bush took special note of U.A.V.'s in his State of the Union address. Members of the Senate Armed Services Committee have indicated they are willing to spend more than the $1 billion the Pentagon is seeking in the 2003 budget.

That does not surprise John E. Pike, director of GlobalSecurity.org and a longtime critic of profligate military spending. Although he warned that much can go wrong in future development, U.A.V.'s are proving themselves so far. "They're cheap, and they work," he said.

Battlefield commanders, accustomed to waiting hours, sometimes days, for the results

of reconnaissance missions, now receive airborne battlefield views instantly on live color television. "It's like watching O. J. in the white Bronco," Mr. Pike said.

Of course, the Pentagon has publicly exaggerated the performance of some weapons — most notably during the Persian Gulf war, when the military boasted about high success rates for the Patriot missile against Iraqi Scuds. Later studies showed the Patriot did not perform nearly as well as the Pentagon had said.

Even so, production of the $4.5 million Predator will triple this year, to a total of 24, supplementing the 75 that the government now has on hand, according to Thomas Cassidy, the chief executive of General Atomics Aeronautical Systems. In addition, the Air Force plans to acquire six models of a new plane, the Predator B, which can fly at 45,000 feet, almost twice as high as the original Predator, making it less vulnerable to enemy fire. Colonel Boone expects to lose about 14 Predators a year from antiaircraft fire, operator error or systems failure.

The Air Force will buy seven more Global Hawks at $35 million each over the next two years, then start buying six a year. That will supplement the current fleet of three Hawks, which were rushed out of development for Afghanistan. One was destroyed in a crash landing at the end of last year in what the Air Force will only describe as a mechanical failure. Global Hawk flights were suspended while the accident was investigated, but by the middle of this month the Hawk was redeployed.

Robotic planes have seen action before. In Vietnam, drone aircraft — far cruder than today's models — flew more than 3,000 missions. Most were on surveillance and reconnaissance, though a few were equipped to fire Maverick missiles. After Vietnam, military spending wound down, and the Air Force put its resources behind the then-new F-15 fighter. Development of robotic aircraft all but stopped at the Pentagon until the 1990's, when military planners began turning their attention to "networkcentric" warfare, the move to tie battlefield weapons, computers and communications systems into a seamless data web.

The same forces that swept through commercial technology in the 1990's were also transforming weaponry and military communications. Computers, bombs, sensors and U.A.V.'s became smaller, smarter, lighter and faster. Pilotless aircraft, loaded with computer intelligence and fast communication links, came to be regarded as essential, airborne nodes on the battlefield information network.

In fact, the major military contractors view such aircraft as just one piece of a big market in networkcentric warfare — currently valued by Frost & Sullivan at $11 billion annually. Mr. Heinz, of Boeing, regards his new group as "a new business unit that would focus the various efforts we have going on all across Boeing" in networkcentric warfare. "We called ourselves unmanned systems, not unmanned air vehicles," he said. "It's mission management, it's integration with the surveillance and reconnaissance systems."

On March 7, for example, Boeing won a $154 million contract to integrate the Army Future Combat Systems program, essentially a communications network to tie together robotic land vehicles, tactical U.A.V.'s and other weapons and sensors. Tactical U.A.V.'s are generally slower, lighter and cheaper than Predator-class planes. They will be used to peer over hills at enemy encampments and send target information back to the artillery without putting human scouts in danger.

Boeing is hunting for partners to help it build a tactical aircraft program, Mr. Heinz said. In February, the company struck a deal with the tiny Insitu Group in Seattle to build a 33-pound robot surveillance plane for the Navy. "We'll be talking with General Atomics, although I don't want to single them out," Mr. Heinz added. (Mr. Cassidy at General Atomics Aerospace would say only that "we are very solvent right now; we can march on to our own drumbeat.")

Industry analysts say another potential Boeing partner is the AAI Corporation of Hunt Valley, Md., the maker of the Shadow tactical U.A.V. Mr. Heinz would add nothing more on the subject nor address rumors that Boeing was seeking a merger akin to the recent move by Northrop Grumman, the No. 5 military contractor, to acquire TRW.

The move toward networked warfare is a big factor behind Northrop Grumman's interest in TRW, according to Norm Sakamoto, vice president for Northrop's unmanned-systems group. TRW is a major provider of satellites and other space-related systems for the American military. "They are big in space, and Northrop Grumman has nothing in space to speak of," he said.

U.A.V.'s are heavy satellite users, sending their data-rich signals through high-bandwidth satellite relays to ground stations and other aircraft. The Global Hawk depends on global positioning satellite signals to keep it steady when it lands. The Pentagon is considering U.A.V.'s as a missile platform to intercept ballistic missiles in the early phase of launching; Brilliant Eyes satellites from TRW would detect those launchings and signal the aircraft to attack.

Another major military contractor, Raytheon (news/quote), expects strong growth in its U.A.V. business. It provides radar, infrared and other surveillance sensors carried by U.A.V's as well as ground stations in which pilots fly the planes via computer. The company is also developing control software that will be common to any kind of U.A.V., so that anyone in any branch of the military trained on one kind of robotic aircraft could easily fly another.

Quantifying the value of the U.A.V. business for Raytheon is difficult, partly because products developed for robotic aircraft can be used in other systems, according to Frank Fleischer, who heads business development for Raytheon's air combat systems unit. For example, it is building the Global Hawk's sensor systems in modules that can also be used in helicopters and manned aircraft. But Raytheon expects that U.A.V.'s will mean billions in revenue as the market grows.

U.A.V.'s are not only pushing development of military technology; they are also pushing the way the Pentagon develops and acquires new systems.

The Global Hawk and the Predator are notable both as the first network-age U.A.V.'s in the American arsenal and as the guinea pigs in a rapid development system that is changing the way the Pentagon buys and designs its weapons. The idea is to use as much off-the-shelf hardware and software as possible in order to move fast while keeping costs down.

The Pentagon also wants to allow the people who would actually use the weapons to play a major role in their design and engineering. The Predator, first produced in 1994, was deployed over Bosnia by 1995. It did not do so well there, according to Mr. Pike, but by the time it saw action in Kosovo, battlefield commanders began to recognize its

potential.

In what is called a "spiral" development process, lessons learned in the field are applied immediately to the design and engineering of the next vehicle. In Afghanistan, Hellfire missiles were jury-rigged to the Predator's wings and a laser-target system was literally taped to its nose. The missiles worked, and new Predators will have points on the wings for carrying light missiles and a laser designator built into the nose.

The X-45 strike plane is being developed spiral-style, too, along with a robot fighter that Northrop Grumman is developing for the Navy. The X-45 is scheduled for action later in the decade, not long after the traditionally developed F-35 comes on line. Already, the Navy is talking about cutting back F-35 orders.

At that point, the Pentagon will consider its budget and its missions and decide whether to buy the one with the pilot on board, or the one without.

The Wall Street Journal

April 10, 2002

PAGE ONE

Military Feels Bandwidth Squeeze As the Satellite Industry Sputters

By GREG JAFFE
Staff Reporter of THE WALL STREET JOURNAL

WASHINGTON -- Even before the Taliban crumbled, U.S. Defense Secretary Donald Rumsfeld boasted that unmanned spy planes, which beamed live pictures of fleeing Taliban and al Qaeda fighters to U.S. pilots and commanders, were one of the stars of the Afghanistan war. The Pentagon has budgeted over $1 billion to buy 37 more of the high-tech aircraft next year.

But the military probably won't be able to fly them all. With the collapse of the commercial-satellite industry, the Pentagon faces a bandwidth crunch: a shortage of the communications hardware that links people on the ground and planes in the air.

Go to Aftermath of Terror[1]

Bandwidth is a measurement of how much data can flow through a network of transmitters, receivers and satellites. More satellites make for a more robust network that can handle more data and more unmanned planes flown by people on the ground.

COMPANIES

Dow Jones, Reuters

Motorola Inc. (MOT)	
PRICE	14.11
CHANGE	0.26
U.S. dollars	11:22 a.m.

General Motors Corp. Cl H (GMH)	
PRICE	16.19
CHANGE	0.11
U.S. dollars	11:21 a.m.

* At Market Close

Remote Control

In late December, Air Force Capt. Elissa Beddow was told to use the Predator unmanned surveillance plane that she operates to hunt for some al Qaeda fighters trying to flee Afghanistan. Sitting in a ground station hundreds of miles away in Pakistan, Capt. Beddow directed the spy plane with a control stick, a computer keyboard and several television monitors that provided live video feeds. She flew the 27-foot-long aircraft up and down the road where the men had last been seen. Thirty minutes into the search, she spotted them.

Over the same satellite link that let her fly the Predator and watch the video, she summoned a Navy fighter jet and led it to the mud hut where the men had parked their sport-utility vehicles. On the video feed, Capt. Beddow saw the al Qaeda fighters milling around their SUVs.

"You almost wanted to scream, 'Run! Get out of the way! You're going to be killed!' " she says. A few minutes later, the fighters were all dead.

In the 1990s, the U.S. military bet that by 2005 almost 1,000 new satellites would be available for weapons such as the Predator that rely on space-based

[Photo]

Static: Use of high-tech planes such as the Predator (above) has been hampered by the collapse of the commercial-satellite industry.

communications. But the commercial-satellite industry, which the Pentagon was counting on to launch those satellites, fell on hard times. Of the 675 launches expected between 1998 and 2002, only 275 satellites reached space, according to Futron Corp., a Bethesda, Md., firm that tracks the industry.

A Major Barrier

Now, the scarcity of satellite links stands as a major barrier to President Bush's vision of transforming the military into a light, lethal force capable of striking anywhere in a matter of days. "The challenge of the future isn't building a great infantry carrier or artillery piece," says Lt. Gen. John Riggs, who is leading the Army's modernization effort. "The challenge is building a system that ensures we get the right information to the right place at the right time on the battlefield."

Even in Afghanistan, a smaller operation than Kosovo or the Persian Gulf War, the military has felt the satellite squeeze. The Pentagon assigned six Predators and two larger Global Hawk unmanned planes to Afghanistan, but it has been able to keep only two Predators and one Global Hawk in the air simultaneously. To conserve satellite capacity, Global Hawk pilots have been forced to turn off some of the aircrafts' sensors and transmit fuzzier, lower-quality video, officials say.

The problem will probably hamper the military at least through the next decade. In February 2000, the Defense Science Board, the Pentagon's internal think tank, concluded that the military would need an average of about 16 gigabits per second of bandwidth -- the equivalent of about 208,000 simultaneous phone calls -- to fight a major war in 2010. Today, the projected requirement, which is classified, is "significantly higher than what we forecast," says Army Brig. Gen. Stephen J. Ferrell, who is heading a study on the Pentagon's communications needs.

Falling Short

The Pentagon plans to launch three of its own satellites between 2004 and 2006, but Defense officials say the additional capacity will amount to only six to 7.5 gigabits. The military will have to make up the difference by buying more commercial-satellite links, but that won't be easy. In Kosovo the Pentagon struggled to buy less than one gigabit per second of capacity because of the scarcity of available satellite links. "All Defense Department-owned communication acquisitions over the next 10 years will not come close to meeting the bandwidth requirements," the Defense Science Board report concluded.

[Photo]

Demand for bandwidth continues to grow as the services develop more data-intensive weapons systems. To reduce risk to men and women in uniform, all of the services are relying increasingly on remote-controlled weapons. Beaming intelligence back to bases in the U.S. for processing also lets the services slash the number of people and tons of equipment they bring to the battlefield.

In 1996 and 1997, Pentagon officials decided to rely on the commercial-satellite industry to produce most

The Global Hawk

of the hardware they would need for these new bandwidth-intensive weapons systems. The military then planned to lease capacity on the satellites. At the time, the growing industry appeared to be on the verge of providing huge amounts of bandwidth to anyone who wanted it almost anywhere on the globe. New companies such as ICO-Teledesic Global Ltd. -- backed by billionaires Bill Gates and Craig McCaw -- said they would use their satellite networks to sell telephone and broadband Internet service to businesses and consumers world-wide. Wall Street poured billions of dollars into the fledgling business. "Ubiquitous satellite communications and unlimited bandwidth seemed the destiny of the world," says Air Force Col. Dave Anhalt, who has studied the issue for the Secretary of Defense's office.

Bandwidth Glut

Fiber-optic cable, which carries huge amounts of information in the form of light beams, ruined the plan. It proved a cheaper and more reliable way of moving gigabits of information around the globe. Scores of companies built fiber-optic networks spanning the world, creating a bandwidth glut that has contributed to the demise of many telecommunications companies.

The cable didn't help the military, which needs wireless connections to tanks, planes and ships. But the surge in fiber-optic networks hurt the satellite companies. In the past few years, ICO-Teledesic and about a dozen other companies -- including **Motorola** Corp.'s Celestri project and **Hughes Electronics** Corp.'s Spaceway project -- have had to cancel, scale back or postpone new satellite launches.

Hints of a Problem

The first hints of a problem for the military surfaced in Kosovo in 1999. During that war, the military's requirements exceeded all of the existing military and commercial-satellite capacity combined. After allotting available capacity to air operations, "we simply couldn't find enough bandwidth to support our ground forces," says Col. Steve Lisi, who was working at the time for Henry Shelton, then-chairman of the Joint Chiefs of Staff.

The Clinton administration and the military had limited the use of ground forces, chiefly because of concerns about casualties and the Army's inability to mobilize a large, capable force quickly enough to make a difference. But the bandwidth crunch weighed on planners' minds, too, Col. Lisi says. "If we had decided to use ground troops, it would have been a real challenge," he says.

The shortage has become more obvious in Afghanistan, largely because of the prominent role played by unmanned Predators and Global Hawks, which are by far the most voracious consumers of battlefield bandwidth.

In the early days of the war, the Predator's usefulness seemed limited. It could beam live pictures of the battlefield to commanders in the U.S. and Saudi Arabia, where the air-operations center was based. But Predator pilots sitting in Pakistan couldn't talk to soldiers on the ground or to fighter pilots in the air to relay what was appearing on their video screens. The pilots were too far away from the ground troops to communicate with conventional radios, which have a limited range.

"We were basically just a nice little reconnaissance platform," Capt. Beddow says.

An Efficient Tool

A few weeks into the war, however, Air Force officials rigged the Predators so that Capt. Beddow and her fellow pilots could talk via satellite to ground troops and fighter pilots in Afghanistan. Over time, the Predators proved an efficient tool for coordinating close air-support missions, in which advancing ground troops work with warplanes circling the battlefield to target and then kill an enemy from the air.

Demand for the unmanned aircraft began to outpace supply. Throughout the war, the U.S. air commanders, stationed at Prince Sultan air base in Saudi Arabia, have had the final say on who got Predators for their missions. That didn't stop some generals, planning missions out of the U.S. and Afghanistan, from calling Predator pilots in Pakistan to demand one. "We'd politely remind them to call Prince Sultan," says Capt. Joe Rizzuto, a Predator pilot.

Meanwhile, Predators and Global Hawks were sitting unused on the runway. The military didn't have enough ground stations for the remote pilots, but even if it had more of those stations, there wasn't sufficient bandwidth to fly all the available planes, defense officials say.

There were other problems. In some areas of Afghanistan, satellite coverage was spotty and the video feed from the planes would fade in and out. To get videos from the Global Hawk planes back to the command center without overwhelming the system, pilots often would have to lower the quality, making the pictures fuzzier.

But the military nevertheless saw unexpected potential in the spy planes. Back in Washington, they are often referred to as "high demand/low density assets," which Mr. Rumsfeld says is Pentagonese for "we didn't buy enough."

He plans to remedy that in next year's budget with purchases that threaten to exacerbate the bandwidth crunch. The Pentagon currently plans to buy 22 Predators, 12 Army Shadow unmanned aerial vehicles and three of the big Global Hawks. Just one Global Hawk consumes about 500 megabits per second of bandwidth, or about five times the total bandwidth consumed by the entire U.S. military during the Gulf War.

Seeking Solutions

Led by the Air Force, the services are seeking new solutions. One option is to manage available bandwidth better. For example, satellite capacity currently assigned to the Predator or the Global Hawk goes to waste when those planes aren't flying and the capacity isn't used by other systems that need it. The services are working on new technology that would allow several systems to share bandwidth from a single satellite transponder. The Air Force's chief of staff, Gen. John Jumper, has pushed for outfitting airborne fuel tankers with antennas that would allow the lumbering planes to function as mini-satellites capable of relaying information within a 300-mile radius.

To expand capacity substantially -- short of spending billions of dollars to launch new satellites -- the military needs an alternative technology. The Air Force Research Lab is working on communication lasers, which can carry far more information than traditional radio frequency, with the Massachusetts Institute of Technology's Lincoln Labs and a few private companies. But shooting a laser beam from space to an orbiting plane is fraught with challenges, in part because beams are degraded by moisture in the atmosphere. Defense officials are optimistic that by the end of the decade they'll be able to use lasers to shoot information from a plane flying at 50,000 feet -- above the clouds -- to an orbiting satellite.

But the Pentagon probably will still have to depend on the commercial-satellite industry for a portion of its needs, says retired Air Force Gen. Bill Donahue, who has been tapped by the

Pentagon to contribute to another bandwidth study. He has suggested that the Pentagon subsidize private companies' satellite launches in return for a dedicated slice of bandwidth in a time of war. The military has a similar deal with the airline industry, which is paid to make available a portion of its fleet in reserve for wartime use.

The Bush administration is hesitant about putting money into the struggling industry. But Gen. Donahue says, "Ultimately, the Pentagon might be in the position of picking the winners and losers."

Meanwhile, in a small, cinder-block building at Eglin Air Force Base near Pensacola, Fla., a team of 25 military officers and engineers led by Col. W. Rhys MacBeth is dreaming up new bandwidth-eating missions for Capt. Beddow's Predator.

Earlier this year, the team rigged a Predator to drop a small sensor that lodges in the ground and beams seismic data, indicating vehicle or tank movement, up through a satellite to Predator pilots and commanders. If the sensor detects something, the pilots can swing their drone in for a closer look. Col. Rhys's team also has rigged the Predator to pass still photographs of potential enemy targets directly to fighter jets so the Predator pilots won't have to take the time to describe enemy positions orally.

"Everyone has an idea of some kind of sensor or munition that they want to hang on the Predator," Col. MacBeth says. For now, the only limit to their plans is bandwidth, he says.

Write to Greg Jaffe at greg.jaffe@wsj.com[2]

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(2) mailto:greg.jaffe@wsj.com

Updated April 10, 2002